

Abstract etc

CHICAGO INTERNATIONAL EXHIBITION

THE MAP OF THE ROCKY MOUNTAINS PARK OF CANADA
AND SURROUNDING COUNTRY

CANADIAN TOPOGRAPHICAL SURVEYS

Executed by means of Photography.



OTTAWA

PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S
MOST EXCELLENT MAJESTY

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ABSTRACT OF THE RESULTS OBTAINED IN CANADA

BY THE

APPLICATION OF PHOTOGRAPHY TO SURVEYING.

The map of the Rocky Mountains Park of Canada and surrounding country sent to the Chicago International Exhibition consists of twelve of the sheets of the Topographical Survey which have been put together. Each of the sheets is ten minutes in longitude by seven and a half in latitude. The scale is 1/40000 and the interval of contour lines 100 feet.

Until recently the land surveys of the Dominion Government were confined to the prairies of Manitoba and the North-west Territories; the operations were simple and consisted merely in defining the boundaries of townships and sections. These lines form a network over the land by means of which the topographical features, always scarce in the prairies, are sufficiently well determined for general purposes.

When the surveys were extended to the Rocky Mountains, the conditions were found to be entirely different and the methods hitherto employed inadequate. The topographical features are well marked; the survey of the section lines is always difficult, often impossible and in most cases useless. Still the proper administration of the country required a tolerably accurate map and means had to be found to execute it rapidly and at a moderate cost.

The ordinary methods of topographical surveying were too slow and expensive for the purpose; rapid surveys based on a triangulation and on sketches were tried and proved ineffectual, then photography was resorted to. The results have been highly satisfactory.

The method is based on the fact that a photograph taken with a suitable lens is a true perspective, in which the focal length is the distance line. By drawing the horizon and principal lines all the measurements which are usually taken on the ground may be obtained from the photograph. There is however, this difference, that while with the ordinary surveying instruments, the topographer is restricted to a few constructions, photography affords a great variety of processes by the application of the inverse laws of perspective.

The first application of mathematical perspectives to surveying is due to Colonel Laussedat, of the French Army; in 1850, he conducted a series of experiments before a commission appointed by the War Office. His perspectives were obtained by the camera lucida. A year or two afterwards, he substituted photography to the camera lucida; this, of course, did not cause any change in the method which remains the same, no matter how the perspectives are obtained and which he described in 1854 in the "*Mémorial de l'Officier du Génie*," No. 16.

It is not proposed to describe here the details of the process or the instruments employed (1); to do so would go far beyond the limits of this paper. The object is simply to give a short review of the work accomplished and of its results.

Regular photographic surveys were commenced in 1888 in the main range of the Rocky Mountains near the Canadian Pacific Railway; they have since been continued without interruption and now cover about two thousand square miles divided as follows:—

1888.....	250 square miles.
1889.....	400 do
1890.....	375 do
1891.....	500 do
1892.....	475 do

The figure for 1892 includes only the surveys completed; by taking into account what was left unfinished, the work of that year is equivalent to a little over five hundred square miles.

(1) The method and instruments of the Canadian surveys are described in "Photographic surveying including the elements of descriptive geometry and perspective by E. Deville, 1889." The book is now out of print.

These surveys were all executed by Mr. J. J. McArthur with a party consisting of one assistant, a packer and a labourer. It will be observed that the area covered each year has increased from 250 square miles in 1888 to about 500 square miles in 1891 and 1892. Want of experience at the beginning accounts for the smaller figures of the first years, but a limit has now been reached which it is not possible to exceed in that part of the Rocky Mountains. Five hundred square miles is the extent of ground which a party, travelling rapidly, can see during one season; as photography, no more than any other process, will permit what has not been seen to be mapped, this must be the limit for that section of the territories. It will of course vary with the nature of the ground, being greater in an open district with large undulations, while it will be smaller in a very broken country like the Selkirk Range in British Columbia. The topographer does not need more than a few minutes at each station to observe angles and expose his plates; the time thus employed during a whole season is trifling and practically he is always travelling except during bad weather. After the short summer is over, the packer and labourer are discharged and the topographer and his assistant employ the balance of the year in plotting their surveys.

A synopsis of the results for any one year, will, better than anything else, permit the advantages of the method to be realized. Taking 1892, for instance, it is found that Mr. McArthur left Morley, his starting point, on the 29th of June. Before that date, the snow was too deep for work. He had to stop on the 17th of October at which time winter had set in and the snow was again too deep for travelling. Of the 111 days intervening, forty-eight were lost through smoke, rain and snow storms, leaving only 63 actual working days. Assuming the work of that season to be equivalent to about 500 square miles, which is slightly below the actual figure, it represents an average of eight square miles per working day.

The plot is made on a scale of 1/20000 and is reduced for publication to 1/40000. Some remarks in an American publication about one of the published sheets (Anthraxite) led to a special examination of that sheet which may be given by way of illustration. The area is 63 square miles. The plot was made from six stations inside and

eleven stations outside of the sheet. One thousand and seventy-five points were fixed by intersection or by constructions equivalent in accuracy ; they were taken from thirty-five photographic views. This corresponds to seventeen points per square mile ; there would be no difficulty in fixing more points and obtaining greater accuracy ; the only limit is the time which can be devoted to the plotting. The rule adopted here is that the topographer and his assistant must plot the surveys of the preceding season before they start again for the field. If at any time, a more detailed plan of a particular locality were required, it could be prepared from the same views without going back on the ground.

The expenditure in 1892 was as follows :—

Packer, \$2.00 per diem	} \$ 429 00
Labourer, \$1.50 per diem	
Transportation	578 50
Living expenses	394 71
Miscellaneous	76 98
Total	<u>\$ 1,479 19</u>

If, to this amount, we add the salary of the topographer, \$1,500 per annum, and of his assistant, \$730, we find a total expenditure of \$3,709.19, which at 500 square miles for the year, brings the cost to \$7.42 per square mile.

This extremely low figure is due to several causes. In the first place, only a very small portion of the topographer's time is spent in surveying operations ; practically, nearly the whole of it can be devoted to travelling for seeing the country and he can map all that he can see. His work consists of two distinct parts ; on the ground he simply collects data and with the exception of a few angles, does not waste any of his time in making measurements. These are left for the winter months, to be attended to in the office, when the only expense is the topographer's and assistant's salaries. In the next place, the party consisting only of an assistant and two men, is much smaller than required for ordinary surveys ; its cost in 1892

was less than \$1,500. The plotting is also more quickly performed, owing to the numerous processes based on the laws of perspective which are at the disposal of the topographer.

But it must not be understood that every photographic survey must prove a success or that a failure after a first trial indicates that the method is defective. The fact is that it requires not only experience, but also a combination of those faculties which make an accomplished topographer. Unlike other methods, he has nothing before his eyes to show the progress of the work on the gaps that may exist in it. His undeveloped plates are his only records ; so every time he exposes one, he must have present in his mind what it will give, what amount of information he will extract from it, what constructions he will apply, what further views are necessary and how they will combine together. These acquirements are not the lot of every surveyor and unless the man is well qualified, his attempts at photographic surveying will not be successful. For this the method is not to blame ; if properly used, it will give results far beyond what could be accomplished by any other process.

E. DEVILLE,
Surveyor-General.

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